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Developing The Smart Grid: Challenges and Opportunities

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Climate change poses serious risks for the global environment but presents new opportunities as well. Significant economic benefits will accrue as the energy paradigm shifts from a system based on a low cost of carbon and ever-increasing demand for electric power to one of high carbon costs and the need to more efficiently manage energy consumption. The concept of the smart grid, which will combine information technology with tools to manage variable renewable power, demand response and distributed power generation, seems ideally suited to address these issues. But moving from concept to reality is not without challenges.

Significance of Legal and Regulatory Environment

No government can afford to pay for all of the changes necessary to moving to the smart grid. A major challenge will be designing the legal, regulatory and tax framework necessary to provide sufficient incentives for the private sector to create the new soft and hard infrastructure that will be needed.

No country will start from scratch so strategies must be developed to make appropriate changes to the existing frameworks over time. Much will depend on the state of legacy systems; how old are the assets, who owns them and to what extent has the electricity market been liberalized?

For example, in the United States, private investors or local communities own most of the generation and transmission facilities. In China and many other developing countries, most of these assets are currently owned by the government. The starting point for making the smart grid a reality under different circumstances must be carefully considered. Legal and policy frameworks will have a major impact on the outcomes and the opportunities that will accompany further development of the smart grid.

Green Technology and Smart Grid Interdependence

Due to rising demand for electric power throughout the world, it is clear that significant bottlenecks will develop if policy makers fail to take action in the near future. For example, many observers believe that large-scale wind and solar plants must be developed outside highly populated urban areas. However, the electricity will not reach customers unless expensive transmission lines are built. Private investors are unwilling to finance the construction of new, two-way transmission lines, unless there is a degree of certainty about the economic viability of renewable power projects. In the absence of a "carbon price" or mandatory interconnection regulations, the economic viability of such projects is highly uncertain.

Another example of the interdependence of green technology and the smart grid is the development of new plug-in electric vehicles. While battery storage technology is improving by the day, electric vehicles will not be manufactured or sold on a massive scale until the smart grid can deliver a multitude of stations where these vehicles can be charged.

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Critical Policy Issues

It is now up to policy makers to decide how to create the right incentives for each of the stakeholders in the smart grid value chain, allocate risks among them in an optimal manner, protect investors against stranded asset risks associated with legacy systems and deliver outcomes at the lowest cost to consumers. To do this, the following factors must be considered:

- **New Methods for Determining Returns and Rates**. In many countries, electricity rates are based on consumption. Accordingly, power companies have no incentive to produce energy more efficiently, with less carbon and in a manner that is flexible for the consumer. Smart grid technology will allow power companies to achieve these goals but the regulators must provide the utility with a guaranteed rate of return based on something other than the amount of power they generate. Some regulators in the United States are experimenting with schemes which decouple the rate of return from consumption, and base it on the installed asset base or efficiency per unit of electricity generated. The opportunity that the smart grid provides is to allow power companies to migrate from a commodity-based business model to a service-based business model.

  Since the smart grid involves the marriage of information technology and power generation and consumption, telecom sector and power sector regulators must carefully coordinate their policy initiatives with tax and consumer concerns to ensure that they do not work at cross purposes. High-speed data and voice infrastructure is a fundamental driver of growth in many economies but their development should be considered alongside power initiatives in order to achieve economies of scale and avoid redundancies. "Dynamic pricing" using smart grid technologies will also allow customers to pay for electricity based on the cost to produce it at different times in the day or by variable sources.

- **Risk Allocation**. Stakeholders in the new smart grid environment include shareholders, contractors, suppliers, product and appliance manufacturers and regulators. The costs and benefits that can accrue to each must be carefully considered in the design of the new regulatory framework to ensure that the risks are allocated to those who are best able to manage those risks. For example, new technologies which supplement old methods can cause significant hardships to incumbents who will have little or no incentive to make necessary changes if they cannot adequately recover the costs associated with legacy systems.

  To encourage transition to the new smart technologies, regulators, particularly in deregulated markets, may need to find ways to mitigate those risks for utilities. For example, in order to ensure the security and reliability of the smart grid, interoperability standards between various parts of the system are necessary. Yet it may be undesirable to wait until those standards are developed to deploy smart grid technologies. Last year, the US Federal Energy Regulatory Commission (FERC) proposed that the costs of certain smart grid deployments could be recovered (in single-issue rate filings) by entities under its jurisdiction without opening all of their costs to reexamination. One of the purposes of this proposal is to accelerate the adoption of new grid technologies in a manner consistent with minimizing the stranded costs of legacy systems.

US Smart Grid Policy

The development of the smart grid presents a tremendous opportunity to all stakeholders in the value chain to transform how we live. A key to making the new "system" function properly is the development of appropriate standards and protocols. In the United States, the Energy Independence and Security Act of 2007 (EISA) gave FERC and the US National Institute of Standards and Technology (NIST) the task of developing and implementing interoperability standards, with participation and input from the private sector.

Using its authority under EISA, FERC last year issued a Smart Grid Policy and Action Plan, which focuses on two cross-cutting issues, and four functionalities it deems critical to the realization of this vision.

The cross-cutting issues were identified as:

- **Security**. This refers to those elements that can affect the reliability of the transmission system.

- **Communications**. This focuses on standard software models needed to ensure accurate communication and coordination at points where two systems need to exchange data with each other.

Key grid functionalities include:

- **Wide-Area Situational Awareness**. This refers to technologies that will give bulk-power system operators access to real-time data. This data will allow them to properly manage congestion and

reliability across the entire system in order to alleviate massive blackouts, such as the one that occurred in the Northeast United States in 2003.

- **Demand Response**. This will allow system operators to interact with power users to vary the supply during period of high demand or unavailability due to variable resources.
- **Electric Storage**. Through new technologies such as reciprocating engines, fuel cells, micro turbines and photovoltaics, a new web of distributed energy resources (DER) can be formed to supplement power generation by the utilities.
- **Electric Transportation**. The advent of widespread use of electric vehicles will place new demands on the power system as millions of cars will need to be charged over large areas in order to allow seamless transportation networks.

Initially Financing the Smart Grid in the US

President Obama made the smart grid a major part of his presidential bid and Congress appropriated a significant amount of funding for this effort through economic stimulus legislation in the American Recovery and Reinvestment Act of 2009 (ARRA).

Recognizing that the smart grid and many green technologies are "infant industries", the US government has sought to stimulate research and development, fund demonstration projects and provide a flexible regulatory framework, which will allow the smart grid to develop over time. For example, the Department of Energy (DOE) has earmarked:

- US$16.8 billion for energy efficiency and renewable energy, including grants for advanced battery manufacturing, alternative-fueled vehicle pilot programs and transportation electrification;
- US$6 billion to cover the cost of guaranteeing loans through the new Innovative Technology Guarantee Program; and
- US$3.4 billion for fossil energy projects related to carbon capture and storage and clean coal initiatives.

Varying Priorities and Opportunities

While most countries will have to consider the major policy issues outlined above, policy makers in each jurisdiction will have different priorities, which will lead to different approaches to system design, and the opportunities that will be presented. For example, the grid in the New York area is over sixty years old. The strategy there is likely to focus on reducing costs and preventing catastrophic power losses. Replacing distribution and transmission assets, key drivers of cost, are likely to have a high priority. On the other hand, Silicon Valley in California has many companies that depend on a high degree of power quality and reliability. In that case, there will be a high demand for sensoring and automated self-healing technologies to address these issues.

In many developing countries, the grid still does not supply a significant part of the population and a significant amount of the power actually generated is not billed. In addition, power theft (or nontechnical losses), has a significant impact on the ability of the utility to operate and finance new power assets. In these cases, remote monitoring, software systems which identify areas where nontechnical losses are occurring and remote disconnect capabilities, will be in high demand.

Three Steps to Consider

So, what are the next steps smart grid participants should take? Here are three steps to consider:

- **Become Part of Decision Process**. Because product and service design will be shaped by the new standards and protocols, it is essential for those who hope to play a significant role in the development of the smart grid to secure a "place at the table" when these issues are decided or, at a minimum, participate in the public comment on reports and proposals as they become available. For example, it may still be possible to join working groups established by NIST on a variety of relevant topics and/or to obtain a seat on the Smart Grid Interoperability Panel Governing Board. While considerable work has already been done, further efforts are needed to address gaps, harmonize standards and incorporate evolving technology.
- **Participate in ARRA-Related Programs**. Non-US companies are eligible to participate in the ARRA-related programs mentioned above, provided that the investment is properly structured from the outset. Generally, this can be accomplished by setting up a so-called "blocker corporation" to hold the ARRA-related investment, thus subjecting the global net income derived from such entity to US federal income tax. Access to US government financing in this way may mitigate some of the financial risks of pursuing early stage projects.

- **Use New Mechanisms to Avoid Risk of Nonpayment or Unauthorized Use of Technology**. The world's leading companies in clean technologies and telecommunications hardware and software have much to contribute to developing countries as they modernize their systems. On the other hand, because of the uncertainty surrounding the enforcement of intellectual property rights in many of these countries, companies may be reluctant to transfer that technology. In order to address these issues, our firm is developing new legal mechanisms that will guarantee licensors against the risk of nonpayment or the unauthorized use of technology.

Conclusion

In the past, power supply has been a local, regional or at best, national concern. Given the challenges posed by climate change, shrinking budgetary resources and the rising demand for power, the smart grid is now a matter of international concern and opportunity as well.

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